Practicals for G10 biology

Model cells

Relevant standards: cells, transport

This is used to demonstrate diffusion in cells, why cells need to be small and how shape affects the reate of diffusion.
Prepare agar with phenolphthalein (10ml phenolphthalein solution per 500ml agar is sufficient). The depth of agar should be no more than 1.5cm, otherwise the experiment will extend beyond available time class time.
When placed in dilute NaOH the agar block will turn pink as NaOH diffuses into the block. Students can time how long it takes for a block of agar to turn completely pink.

Activity:
Students are directed to cut two different sized cubes from the agar and time how it takes for each cube to discolour completely.
e.g. a block 1cm x 1cm 1cm versus a block 0.5cm x 0.5cm x 0.5cm

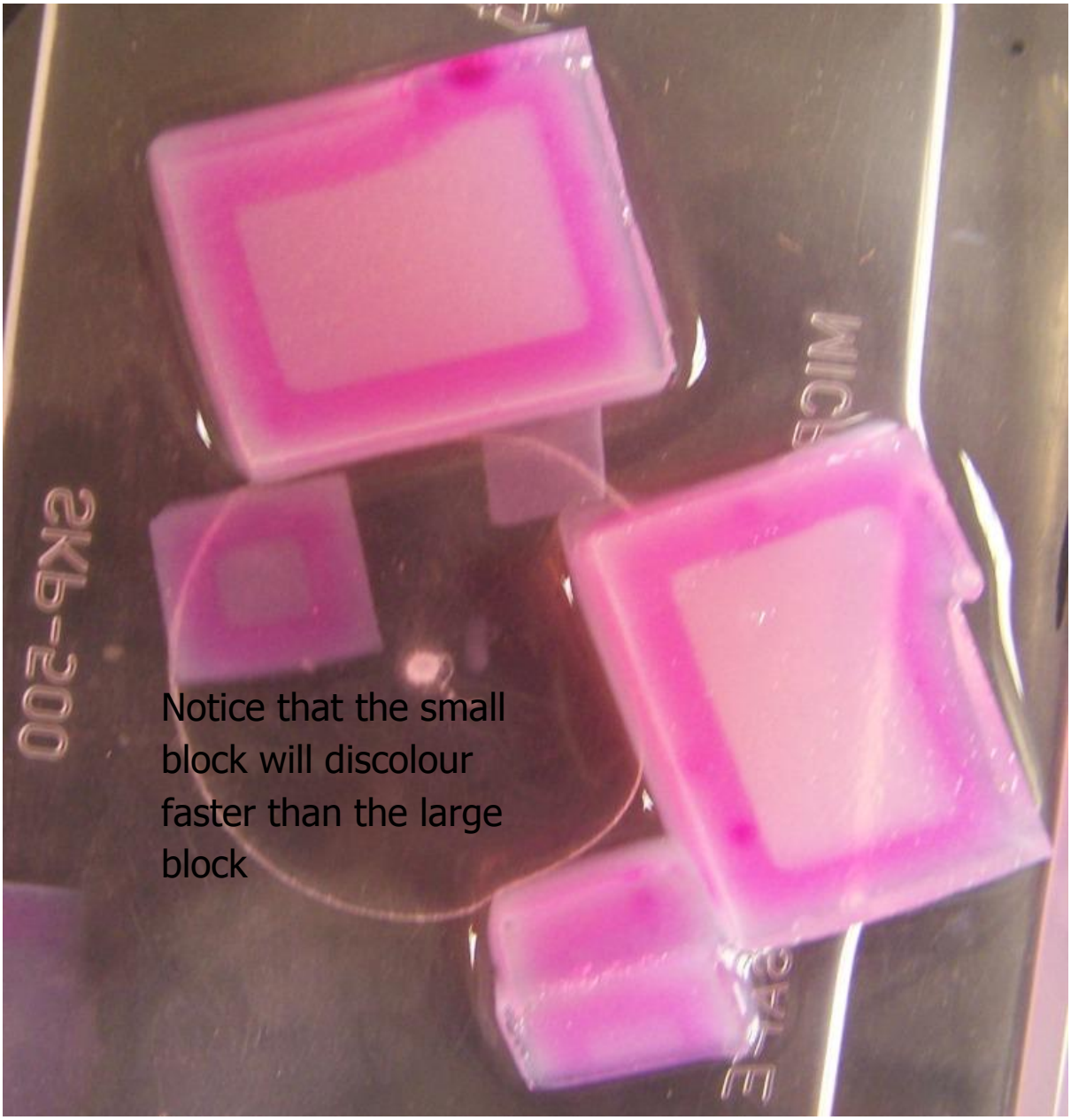
Prepare a table as follows:

	surface area (cm^2)	Volume (cm^3)	Surface area/volume ratio	Time (s)
block 1cm x 1cm 1cm	6	1	6	
block 0.5cm x 0.5cm x 0.5cm	1.5	0.125	12	

Students should discover that it takes much less time for a small 'cell' to discolour than the large 'cell'.

Ask the students to calculate surface area/volume ratios for larger and smaller cells and predict the rate of diffusion. Since the transport of many substances within cells is a passice process (i.e. diffusion), ask the students to relate small cell size to reliance on diffusion.

Extend the idea to larger organisms or specialised cells, such as the root hair cell. Invite the students to cut agar blocks of equal volume but different surface area. Make it a competition. Whose block will discolour the fastest? How does shape influence rate of diffusion?
Students should discover that elongated or flattened 'cells' will discolour faster than cubic blocks.
Ask students to explain how earthworms use this principle to exchange gases efficiently across the skin surface.


Notice that the small block will discolour faster than the large block

Enzymes

Relevant standards: enzyme action

Digestion of albumen

Prepare albumen from fresh egg white. Disperse the runny part of the white in 400 ml of water and heat, stirring constantly. The egg white will eventually denature and form a cloudy suspension.
Allow any large pieces to settle or decant the suspension before use.

Prepare trypsin or pepsin solutions in water. About 0.1g powder to 200ml water.
Activate each enzyme later with acid or alkali.

(Alternately, prepare pepsin in a dilute HCl solution (pH 2) and prepare trypsin in a saturated solution of NH_4HCO_3 (pH 8) ,although this method will restrict the number of modifications which could be carried out later.)

The enzyme solutions do not last well and should be prepared fresh on the day of the practical, or kept overnight in the fridge.

Various controls can be introduced to this experiment and there is plenty of scope for students to design their own experiments on this theme.

One way is to compare the activity of each enzyme. Add equal volumes (~2ml) of enzyme solution to separate test tubes. Add dilute HCl to pepsin to activate it and add an equal volume of albumen suspension. Time how long it takes to clear.
Trypsin might be similarly activated by adding limewater, for example.
A number of variables could be changed to investigate enzyme activity, e.g. different temperature regimes, changing pH, altering concentrations of enzyme or substrate.


93613 Trypsin
Trypsine
Biochemical
BDH Chemicals Ltd Poole England
Pepsin A
powder (3.4.23.1)
Prod 39032
Albumin suspension

Osmosis in potato

Relevant standards: cells

Make up 4 different solutions of sucrose as follows:

0.1 M, 0.3 M, 0.5 M, 0.7 M

Students fill a beaker with each solution and a fifth beaker with water (this is 0.0 M sucrose) If you have a cork borer it is easy to make chips of uniform size, however rectangular chips may be cut if necessary.

Cut five similar chips from a potato. Although changes in length may provide satisfactory data, it is preferable to record changes in mass.

Dry each chip and weigh it.
Place each chip in a different beaker. Ask the students to record any observations. They will notice that some float and others sink. Ask the students to make a prediction about what will happen to the chips over time.

Leave for at least 2 hours. Ask the students to record which are floating and which are not. Has there been a change? Ask students for their reasons why.

Students may have an intuitive idea that something is moving in & out of the potato chips, but may be unsure whether this is water or sugar at this stage.

Ask the students to remove the chips and dry them. Record any differences in appearance and texture and try to account for them.

Weigh the chips. Record any change in mass. Calculate % change from

change of mass/original mass

Have the students plot a graph of % change in mass versus concentration of solution.
The curve will intersect the x axis where concentration inside the potato = concentration outside the potato. They can therefore determine the concentration of cell sap in terms of sucrose.

Potato chips in different sucrose concentrations.

Taxonomy

Relevant standards: classification of organisms

The usual approach is to have students separate articles into categories (e.g. nails, screws, bolts or contents of their pencil case).

For greater biological relevance students may be asked to sort model animals and/or dinosaurs into groups. Ask the students to justify their groupings.
Students are usually able to classify organisms intuitively.

Extension: Ask students to develop a key for the organisms they have sorted into groups.

Paper chromatography

Relevant standards: molecules, cells

Separation of chlorophyll requires volatile chemicals and is laborious to prepare.

The principle of paper chromatography may be illustrated by using a water-soluble marker. Make a dot and allow the pigments to separate by dipping one end of the paper strip in water. Take care not to wet the sides of the strip if using a test tube.
An alternative way is to use a piece of round filter paper, place the dot at the centre and cut a wick to the centre of the circle. Rest the paper on a beaker with a small amount of water in it. Allow the wick to dip into the water. Eventually the pigments will disperse in a circular pattern.

Population genetics

Relevant standards: inheritance, populations

Coloured beads or beans are a useful tool to demonstrate monohybrid crosses and Mendelian ratios.
The exercise lends itself to group work since many 'crosses' have to be carried out to approach the theoretical 1:2:1 genotypic ratio.

Suggested activity:
Give the students 10 red beans and 10 white beans in a paper cup. Without looking, they draw out pairs of beans and record the tally of red/red, red/white and white/white. Have them repeat the exercise several times. Combine class results on the board. Compare with theoretical ratio.

Extension: Show how alleles may be selected for or against by removing particular phenotypes from our bean gene pool. For example, if all the white/white individuals are albino and therefore visible to predators, they will be more likely to be eaten without leaving offspring.

Model multiple allele systems by introducing a third bean colour.

Model the effects of migration, genetic drift or founder effect.